Detailed Project Report
Lighthouse Beach
Chatham, Massachusetts

EMERGENCY SHORELINE PROTECTION

December 1991

US Army Corps of Engineers
New England Division

EMERGENCY SHORELINE PROTECTION

LIGHTHOUSE BEACH

CHATHAM, MASSACHUSETTS

DETAILED PROJECT REPORT

Department of the Army
New England Division, Corps of Engineers
Waltham, Massachusetts 02254-9149

DECEMBER 1991

DETAILED PROJECT REPORT
LIGHTHOUSE BEACH
CHATHAM, MASSACHUSETTS

EXECUTIVE SUMMARY

This report provides the results of a detailed study, accomplished under the special continuing authority contained in Section 14 of the 1946 Flood Control Act, as amended, to determine the need and feasibility of providing shoreline erosion control measures at Lighthouse Beach in Chatham, Massachusetts. The study investigated several alternatives for protecting a 40 foot high embankment adjacent to a public parking area and Main Street. The study was initiated at the request of the Chatham Town Administrator.

The Town of Chatham is located at the "elbow" of the Cape Cod peninsula, about 91 miles southeast of Boston and 17 miles east of Hyannis, Massachusetts. The erosion site is located adjacent to a town parking lot (scenic overlook) and Main Street, which is a principal north-south access through Chatham.

During a severe coastal storm on October 30, 1991 a significant section of a 460 foot long, 40 foot high easterly facing backshore embankment was destroyed. This erosion caused the loss of about 160 feet of paved sidewalk and granite curbing at the top of the embankment. Currently the exposed area has left the entire parking lot and adjacent roadway (Main Street) vulnerable to destruction from subsequent storms.

The study has determined that a plan of stone slope protection consisting of a 6 foot thick armor stone on bedding layers of smaller stone, up to elevation 20 NGVD, would provide a high degree of shoreline protection. The estimated first cost of this plan is $980,000 with an annual cost of $96,300. Total annual benefits associated with the protection of Main Street are estimated at $174,000. The project is therefore economically justified with a benefit-cost ratio of 1.81 to 1.

It is recommended that, subject to conditions of local cooperation as outlined in this report, the proposed project be constructed. The estimated non-Federal cost share is estimated at $490,000.

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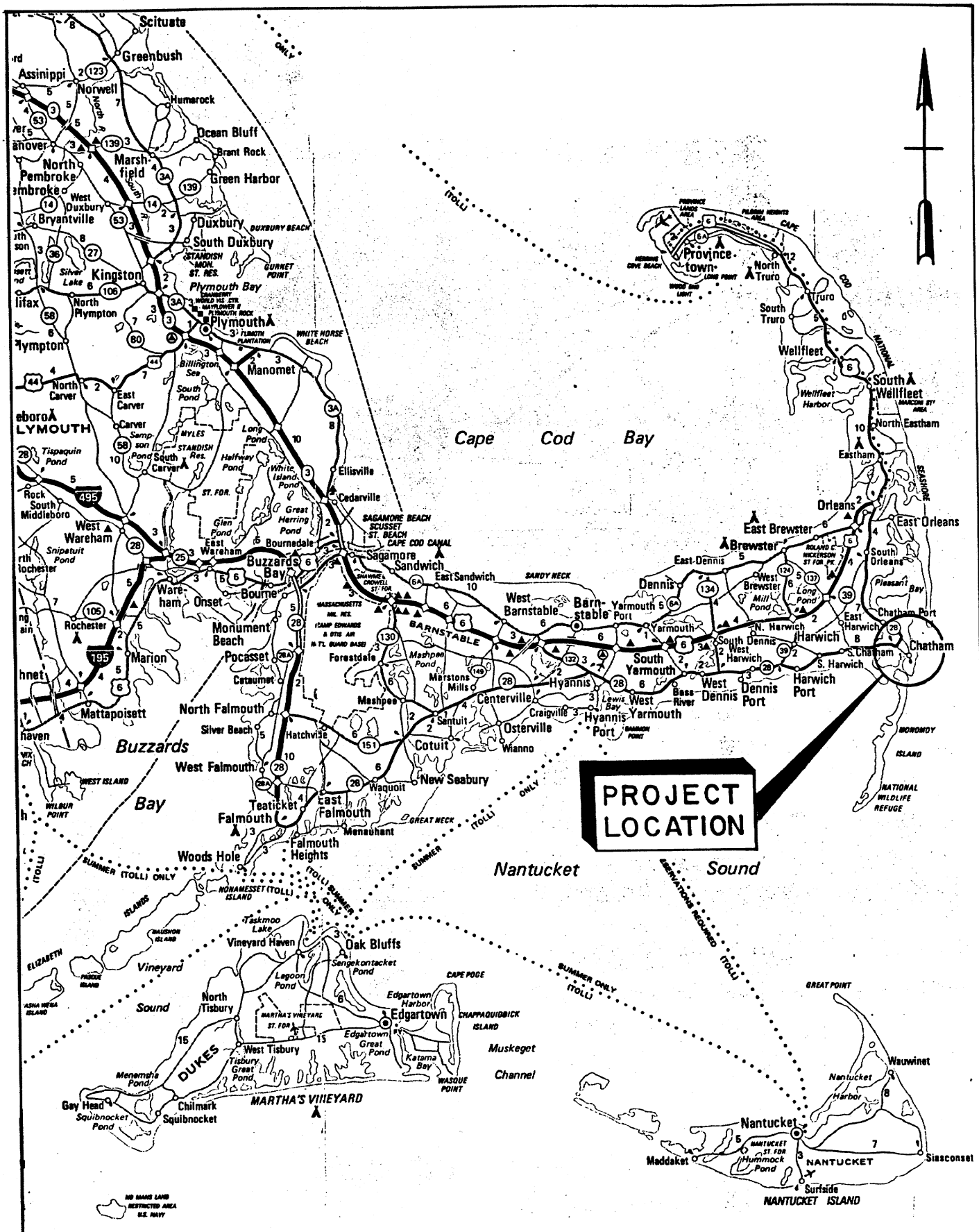
1. STUDY AUTHORITY

This report provides the results of investigations, accomplished under the special continuing authority contained in Section 14 of the 1946 Flood Act as amended, to determine the need and feasibility of constructing shoreline embankment protection at Lighthouse Beach, Chatham, Massachusetts. Section 14 allows for Corps of Engineers participation in the construction of economically justified streambank and shoreline erosion control projects when essential public works or public use facilities are endangered by erosion. Non-Federal cost sharing by a legally empowered and financially responsible local sponsor is a requirement of the Section 14 authority. Federal participation for any single project, under the Section 14 authority, is currently limited to $500,000. Federal assistance for alleviating the severe erosion problem at Main Street was requested by the Chairman of the Chatham Board of Selectmen.

2. DESCRIPTION OF STUDY AREA

The Town of Chatham, Massachusetts is located at the "elbow" of the Cape Cod peninsula, about 91 miles southeast of Boston and 17 miles east of Hyannis, Massachusetts (see Plate 1, Location Map). Principal access to Chatham is provided by Massachusetts Route 28. Chatham is bordered to the north by Pleasant Bay, to the east by Chatham Harbor, and to the south by Nantucket Sound. The current population of Chatham is estimated at about 7200, while summer tourism normally triples this amount.

The erosion site is located at the easterly facing shore front adjacent to Main Street, which is a principal north-south access through Chatham (see Plate 2, Vicinity Map). Other public facilities in this area include the Chatham Lighthouse and U. S. Coast Guard Station, as well as a public parking lot that is heavily utilized as a scenic overlook by the tourist population. The erosion area is about 460 feet long and is bordered by previously constructed revetments at its northerly and southerly limits. The embankment is about 40 feet high.



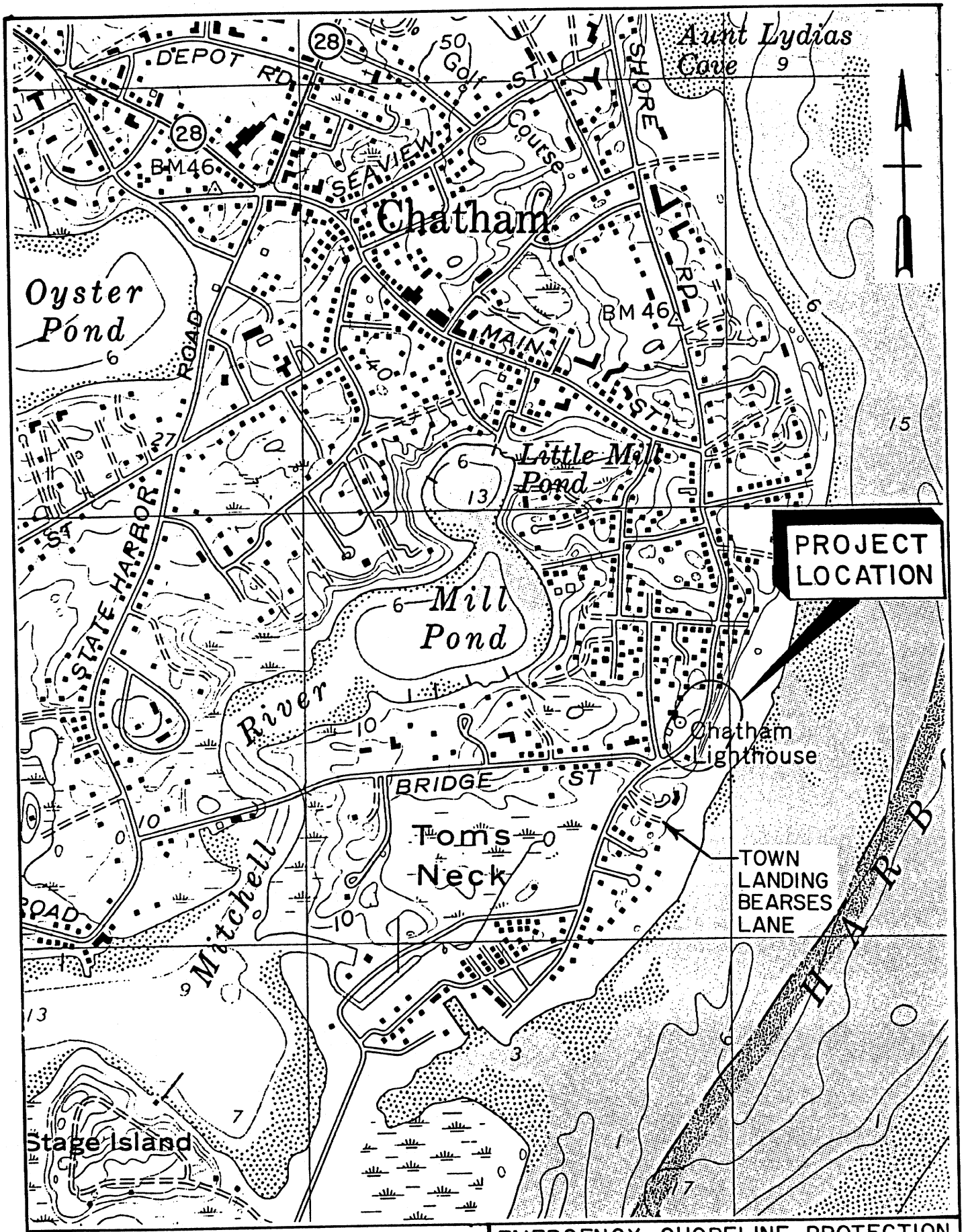
LOCATION MAP

EMERGENCY SHORELINE PROTECTION

LIGHTHOUSE BEACH

CHATHAM, MA.

SCALE: 1"=7.5 MI.	DEC. 1991	PLATE 1



VICINITY MAP

EMERGENCY SHORELINE PROTECTION

LIGHTHOUSE BEACH

CHATHAM, MA.

SCALE: 1" = 1000'	DEC. 1991	PLATE 2

3. EROSION PROBLEM

During the severe coastal northeast storm of January 2, 1987, a breach of the coastal barrier (Nauset Beach) occurred almost due east of the current problem area (Lighthouse Beach). In the first three months after the breakthrough the initial 20 foot wide breach increased to 3300 feet. Across from the breach, along the Chatham mainland, attack by ocean waves triggered massive shoreline erosion. Several private homes were lost during the January 1987 storm and this condition was primarily responsible for the private revetments being constructed adjacent to both ends of the current problem area. Subsequent storms have resulted in larger waves passing through the breached area and the newly unprotected inner shoreline has been subjected to a rapidly increasing rate of erosion.

On October 30, 1991, a storm similar to the January 1987 event occurred, causing extensive coastal damage along the easterly facing Massachusetts coast. This storm exacerbated the erosion condition at Lighthouse Beach to such an extent that large quantities of highly erodible bank materials were lost in the area between the two revetments and portions of the parking lot at the top of the bank were undermined. At this time the existing slope of the embankment is nearly vertical and the high tide line is directly at the base of the slope. Photos of the problem area are contained on the following pages.

4. PLAN FORMULATION

Prior to formulating a plan of protection for Shore Road, a "without project" condition was evaluated to determine impacts to the area and the community if a protection project was not constructed. Without providing any form of erosion protection the embankment would continue to erode and would not only eliminate a valuable resource to the community, namely, the scenic overlook parking lot, but would also eventually destroy this section of Main Street. Over a period of several years the continued erosion could impact on the Coast Guard property and the lighthouse itself.

The two primary alternatives investigated for protection of the roadway included either relocation or stabilization of the embankment with stone slope protection or sheet pile, timber, or precast concrete walls. Relocation of a 500 foot long portion of the roadway was determined to be impractical for two primary reasons. First, the relocation would have to extend beyond the Coast Guard property to adjacent private property. This land taking would be very expensive. Secondly, without bank protection, the erosion would continue and within a few years the relocated roadway could be subjected to erosion conditions again.

Chatham Lighthouse Beach
September 1963

PHOTO 1 (Nov. 91)

Looking South along top of Embankment

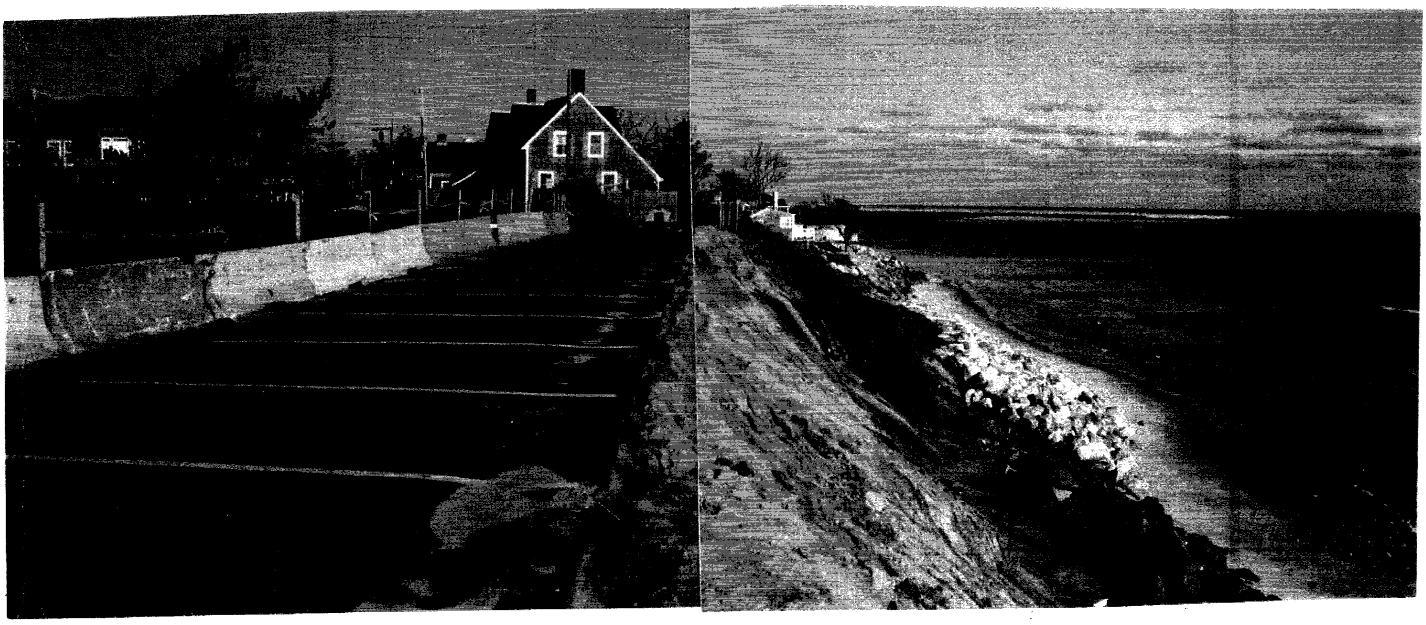


PHOTO 2 (Nov. 91)

Looking North along top of Embankment
Note: 6' wide Sidewalk Missing

PHOTO 3 (Nov. 91)

Entire length of Eroded Embakment

PHOTO 4 (Nov. 91)

Northerly section of Eroded Embankment

PHOTO 5 (Nov. 91)
Existing Revetment at Base of Slope

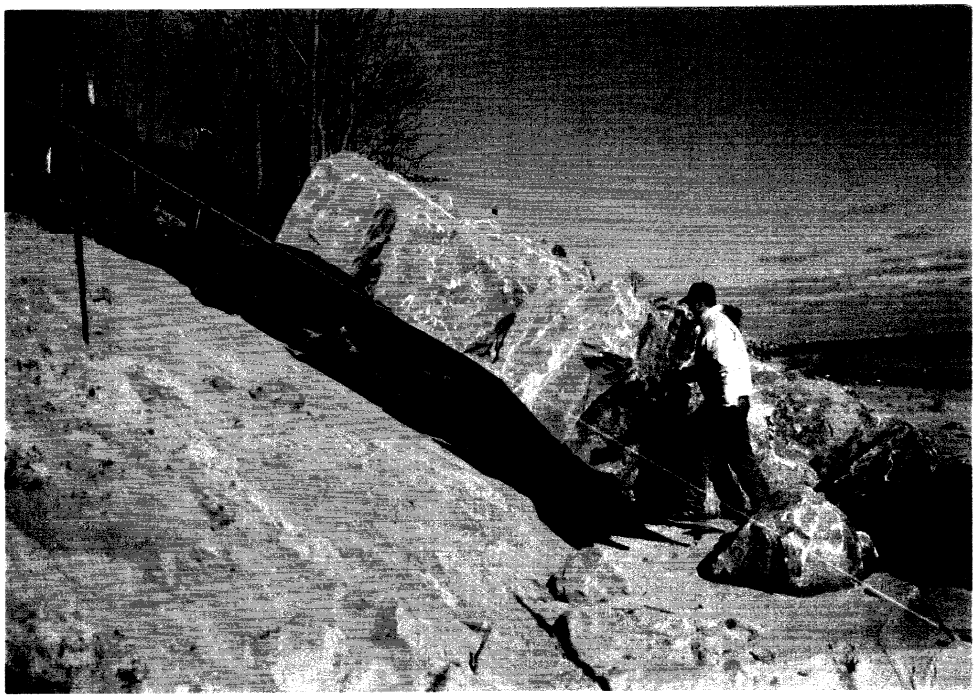


PHOTO 6 (Nov. 91)
Stone placement in area adjacent
to Erosion Site

Although detailed engineering design was not accomplished for alternative plans of protection, it is estimated that costs for sheet pile or concrete walls would exceed costs for stone slope protection. Alternative designs such as gabions or timber crib walls would not provide permanent protection against ocean wave forces. The initial evaluation of a revetment included review of a plan, prepared by Coastal Engineering Company for the Town of Chatham, to determine if it met criteria for Corps of Engineers design. At the time of our review, the private company estimated project construction costs at about $800,000. This design featured a stone toe utilizing 6 to 8 ton rock with only filter fabric under the stone. Although this design had basically withstood the most recent storm adjacent to the problem area, as part of plan formulation we investigated alternate designs that would be acceptable to Corps criteria and the local community. This formulation determined that a stone slope protection project, utilizing Corps design criteria, would be the least costly and most acceptable plan of protection.

5. SELECTED PLAN

The erosion site is about 460 feet long. The selected plan of erosion control at Main Street includes backfilling of the eroded area with compacted random fill and placement of a 6 foot thick layer of armor stone (2-3 ton stone) on a 3 foot thick layer of underlaying stone (400 to 500 lbs. stone). A 1.5 foot layer of bedding stone would be required under these two upper layers. This stone would be placed on a 1.5 horizontal to 1 vertical slope up to elevation 20.0 NGVD. Between elevations 20 and 40 NGVD, a 6 inch layer of seeded topsoil should be placed on a 2 horizontal to 1 vertical slope. The toe of the structure would extend 14 feet onto the beach with the same layer thickness as on the slope. A plan view and cross sections are shown on Plates 3, 4 and 5. The proposed project is primarily located on property owned by the Town of Chatham. A detailed technical analysis of the selected plan is contained in Appendix A, Technical Engineering.

6. ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

Estimates of first costs and annual charges for the proposed project are presented in Table 1. An annual cost of $500 for maintenance at the project after construction has been included as a non-Federal responsibility. Annual costs are based on the current Federal interest rate of 8 1/2% and amortized over an estimated project life of 25 years.

N

Existing Lighthouse

Property of United States Government
Coast Guard Chatham Light

Town of Chatham

℄

℄

℄

℄

B
5

A
4

Existing concrete barriers

MAIN STREET

280'±

160'±

Chatham Beach
Tennis Club

Transition to
match existing

Town of Chatham Parking Lot

Transition to
match existing

T.R., II and C.H.
Pennypacker

Existing
revetment
under constr.

×El.
34±

Existing granite curb

×El. 36±

Existing bit. conc. sidewalk

×El. 41±

Granite curbing

6'-wide bit. conc. sidewalk

Top of Bank

El. 20.0

Exist. guide rail to be replaced
with new - 440 L.F.

Existing wooden stairway
to be removed

6" topsoil, seeded

S = 1 on 2

12'

El. 20.0

El. 20.0

Proposed revetment

S = 1 on 1.5

Existing
revetment

El. 10.0

14'

El. 5.5

Approx. M.H.W.
after 10/30/91
Storm

Limits of sand replacement

S = 1 on 5

El. 3.3, Observed
M.H.W. - 9/18/91

Match existing beach

B
5

A
4

Access from
Town Landing
Bearses Lane

℄

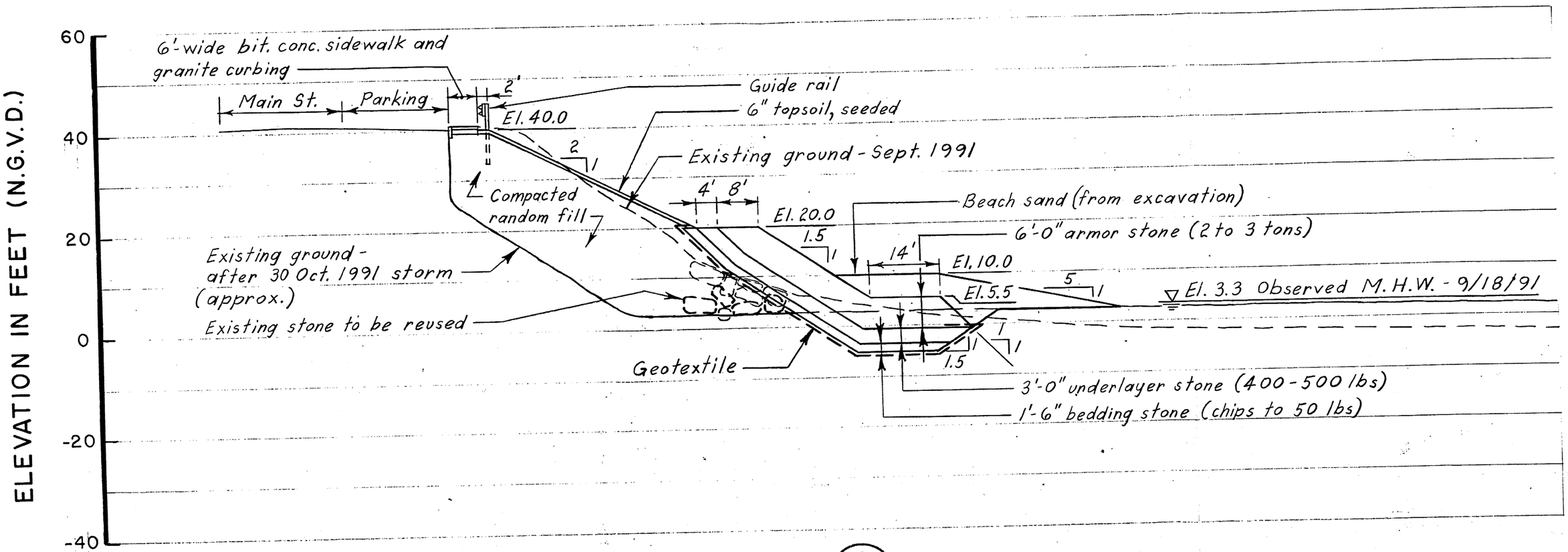
PLAN

EMERGENCY SHORELINE PROTECTION

LIGHTHOUSE BEACH

CHATHAM, MA.

SCALE: 1" = 40'	DEC. 1991	PLATE 3



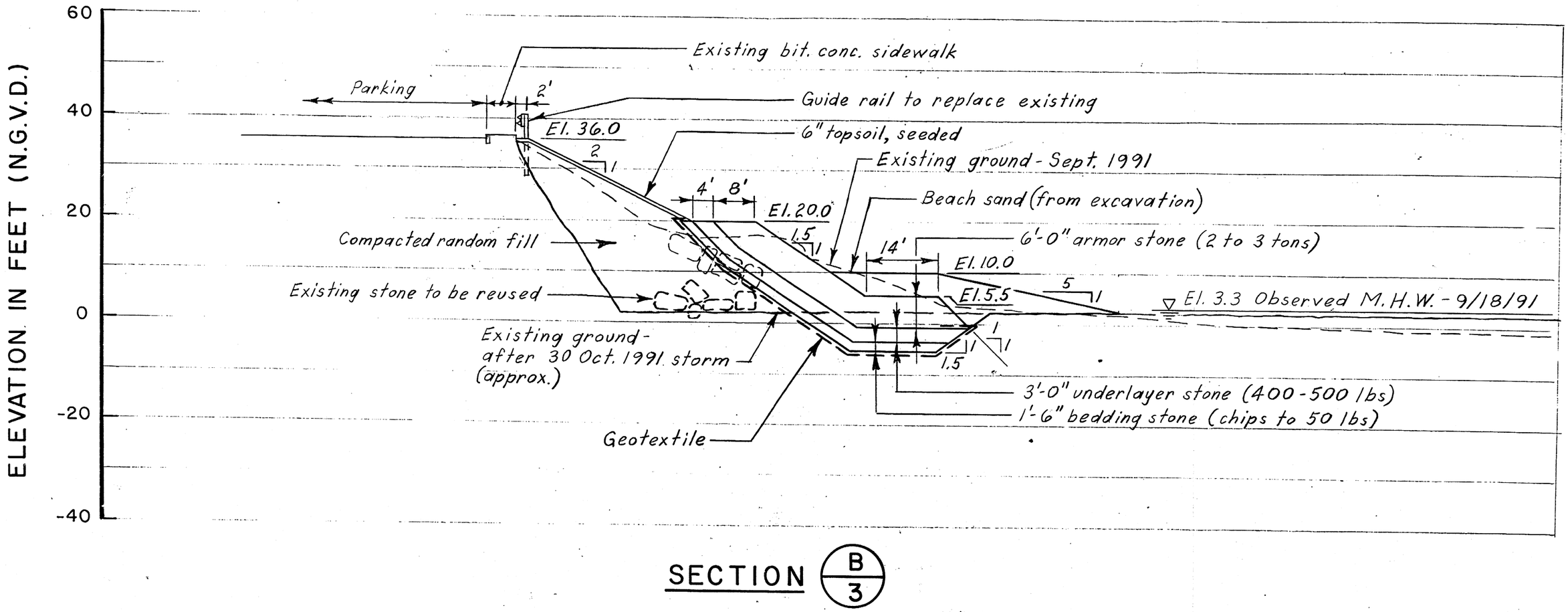
SECTION A/3

EMERGENCY SHORELINE PROTECTION

LIGHTHOUSE BEACH

CHATHAM, MA.

SCALE: 1" = 20'	DEC. 1991	PLATE 4



SECTION B/3

EMERGENCY SHORELINE PROTECTION
LIGHTHOUSE BEACH
CHATHAM, MA.

SCALE: 1" = 20'	DEC. 1991	PLATE 5

TABLE 1

ESTIMATES OF FIRST COSTS
AND ANNUAL CHARGES

FIRST COSTS

ITEM	QUANTITY	UNIT	UNIT PRICE	COST
EXCAVATE EXISTING ARMOR STONE	1,110	CY	35.00	$ 38,850
EXCAVATE SAND	4,000	CY	5.00	20,000
GEOTEXTILE FABRIC	3,900	SY	3.60	14,040
BEDDING STONE (≤50 LBS.)	1,620	CY	30.00	48,600
UNDERLAYER STONE (400-500 LBS.)	2,620	CY	65.00	170,300
ARMOR STONE (2-3 TONS)	4,670	CY	78.00	364,260
COMPACTED RANDOM FILL	17,000	CY	9.50	161,500
6" TOPSOIL AND SEED	2,700	SY	6.00	16,200
GRANITE CURB	160	LF	25.00	4,000
4" BIT CONCRETE SIDEWALK	800	SF	2.00	1,600
12" COMPACT GRAVEL BASE	35	CY	20.00	700
REMOVE WOODEN STAIRWAY	1	JOB	LS	500
REMOVE EXISTING GUARD RAIL	280	LF	5.00	1,400
INSTALL NEW GUARD RAIL	440	LF	25.00	11,000
			SUBTOTAL	$852,950
			CONTINGENCY	74,050
			TOTAL CONSTRUCTION COST	$927,000
			ENGINEERING AND DESIGN	30,000*
			SUPERVISION AND ADMINISTRATION	23,000
			TOTAL ESTIMATED PROJECT FIRST COST	$980,000

*Does not include pre-authorization costs of $10,000.

ANNUAL COST

INTEREST & AMORTIZATION	$ 95,800
OPERATION & MAINTENANCE	500
TOTAL ANNUAL COST	$ 96,300

7. ESTIMATES OF BENEFITS AND BENEFIT COST RATIO

The purpose of this section is to evaluate the benefit and cost of improvement plans at Lighthouse Beach in Chatham, MA to prevent shoreline erosion. An improvement plan is economically feasible if it has a benefit cost ratio greater than one. Project benefit and cost is stated in the December 1991 price level. The applicable interest rate for use in evaluating Federal water resources improvement projects for fiscal year 1992 is 8 1/2%.

The economic resource that is immediately endangered is about a 500 foot section of Main Street in front of the Coast Guard station and in back of Lighthouse Beach. This site is located just north of the terminus of Main Street at its intersection with Bridge Street. According to information provided by the Cape Cod Commission, traffic counts taken north of the site on Main Street indicate a year round total of 5,211 vehicles per day. Underneath the road, on the west side there is a water pipeline, and on the east side, a natural gas pipeline. Above ground on both sides of the road are utility poles with electric, telephone and cable TV lines.

The without project condition and the no action condition are considered to be the same. Without a project erosion will continue unabated forcing the closure of Main Street in back of Lighthouse Beach with the rerouting of traffic. Additionally, the gas pipeline and two electric utility poles will have to be relocated.

With the project there are two major types of benefits- (1) elimination of two traffic detour costs and (2) utility relocation cost. Traffic detour cost has two components - vehicle operating cost for the additional mileage necessitated by the detour, and the value of time lost by vehicle occupants. The detour would run from the intersection of Main Street with Shore Road, along Main Street to its intersection with Stage Harbor Road, along Stage Harbor Road to its intersection with Bridge Street and then from Bridge Street to its intersection with Main Street just south of Lighthouse Beach. The full length of the detour would necessitate approximately two additional miles for travellers. As not all vehicles will be making the full detour, one half mile is taken as the additional distance travelled due to the detour.

Not all vehicles in the traffic count are anticipated to be detoured. With the loss of the parking lot and overlook in back of the beach, it is anticipated that fewer vehicles will be using Main Street. Additionally, other vehicles in the traffic count would not be delayed if their trip did not extend to Lighthouse Beach. Thus in estimating delays the year round traffic count is reduced by 50 percent. The variable cost per mile of operating a vehicle has been estimated by the Corps to be $0.20. The annual cost (rounded to the nearest hundred) is estimated to be:

5,211 vehicles X 0.5% X 0.5 miles X $0.20 per mile X 365 days = $95,100.

The value of time lost by car occupants following the detour is determined by taking the product of the annual number of vehicles detoured, the number of occupants per vehicle, the hourly delay and the value of time. The detour time assumes an operating speed of 35 miles per hour for one half mile. The value of time is taken as leisure which is valued at one third the average hourly wage of $11.75, or $3.92. The value of time lost is estimated to be:

5,211 vehicles X 0.5% X 365 days X 1.5 people X 0.014 hours X $3.92 = $78,300.

The assumptions used to determine detour cost are summarized in Table 2.

TABLE 2
DETOUR COST ASSUMPTIONS SUMMARY
LIGHTHOUSE BEACH, CHATHAM, MA

Detour (miles)	0.5
Vehicle Count (daily)	5211
% Vehicle Count Detoured	50
Variable Operating Cost per Mile	$0.20
Hourly Value of Leisure Time	$3.92
Passengers per car	1.5
Detour Operating Speed (mph)	35

The second major benefit category is the elimination of relocation cost for utility lines. The Colonial Gas Company has estimated the cost of relocating the gas line to the east side of Main Street to be $6,500. The cost of relocating TV and telephone cable were minor. The cost of relocating the electric power lines could not be obtained in time for this report, but is not expected to be large. The $6,500 annualized at 8 1/2% for a 25 year project life is $600.

A third benefit that is not formally part of the analysis, would be the prevention of reduced response time for the Coast Guard in an emergency situation. The Coast Guard currently has a requirement to have a boat in operation at Aunt Lydia's Cove within 30 minutes. It currently takes 10 minutes to reach the Cove from Main Street. Following the detour, according to Coast Guard estimates, the trip could take an additional 15 minutes during the busy summer season when streets are congested. Thus the Coast Guard will have to either relocate personnel closer to Aunt Lydia's Cove or suffer a degradation in their ability to respond to an emergency situation. It is not known at this time which option the Coast Guard will choose.

A comparison of project benefit and cost is made in Table 3. Annual benefit is $174,000 and annual cost is $96,300, for a benefit cost ratio of 1.81 and net benefit of $77,700.

TABLE 3
PROJECT EVALUATION
LIGHTHOUSE BEACH, CHATHAM, MA
25 Year Project Life,
interest rate 8 1/2 %

Annual Benefit	
Transportation Cost	$ 95,100
Value of Time	$ 78,300
Relocation Cost	$ 600
Total	$174,000
Annual Cost	$ 96,300
BCR	1.81
Net Benefit	$ 77,700

8. ENVIRONMENTAL CONSIDERATIONS

The existing project area includes a coastal bank approximately 40 feet high. Vegetation cover at the top and side slope of the bank is low due to erosion of the site. Mean high water reaches the base of the bank throughout the project site.

The remains of an existing protection structure was uncovered by the last storm event. This revetment and slabs of asphalt paving from the parking lot can be seen at the base of the coastal bank. The proposed project would complete the protection of this area by continuing the line of existing revetments immediately north and south of the proposed project area. A wetlands Order of Conditions is currently being obtained by the local sponsor and other State permits are proceeding under emergency authorizations. We will be preparing an Environmental Assessment during Engineering Plans and Specifications.

9. REQUIREMENTS OF LOCAL COOPERATION

During preparation of this DPR, close coordination has been maintained with both Town and State representatives. The Commonwealth of Massachusetts will be the official sponsor of the proposed work and members of the Massachusetts Department of Environmental Management will sign the Local Cooperation Agreement (LCA) prior to construction. The Commonwealth in turn will have a reciprocal agreement with the Town of Chatham. Letters of Intent from the Town and the State, indicating their willingness to support the project and meet required items of local cooperation, are included in Appendix C.

The draft Local Cooperation Agreement (LCA) indicates that the local sponsor will:

a. Provide without cost to the United States, all lands, easements, rights-of-way, and utility relocations necessary for project construction.

b. Hold and save the United States free from damages due to the construction, operation and maintenance of the project, except where such damages are due to the fault or negligence of the United States or its contractors.

c. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army. Annual maintenance costs are currently estimated to be $500.

d. Prevent future encroachment which might interfere with proper functioning of the project.

e. Comply with Title VI of the Civil Rights Act of 1964 (78th Stat. 241) and Department of Defense directive 5500.11 issued pursuant to and published in Part 300 of Title 32, Code of Federal Regulations.

f. Assume responsibility for all costs in excess of the Federal cost limitation of $500,000.

g. Provide 25 percent of the total project costs (excluding pre-authorization study costs), including necessary project lands, easements and rights-of-way. The total non-Federal contribution is currently estimated at $490,000.

10. RECOMMENDATIONS

I recommend that this report be approved as a basis for the preparation of plans and specifications and construction of the selected plan described herein under authority contained in Section 14 of the 1946 Flood Control Act, as amended. I further request that the New England Division Engineer be designated the approval authority for the construction plans and specifications.

Recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted for authorization and/or implementation funding. However, prior to transmittal, the sponsor, the state, interested Federal agencies, and other parties will be advised of any modifications and will be afforded and opportunity to comment further.

Date 18 Dec 91

Philip R. Harris
Colonel, Corps of Engineers
Division Engineer

APPENDIX A

TECHNICAL ENGINEERING

APPENDIX A

TECHNICAL ENGINEERING

1. Summary. Severe erosion along the back shore of Lighthouse Beach in Chatham, MA is endangering a municipal parking lot and the adjacent public way. The erosion was caused by severe wave attack at the base of the slope. The recommended solution includes construction of an armor stone revetment on a 1 vertical on 1.5 horizontal slope. The armor stones should range in size from 2 to 3 tons based on a 7.0 foot breaking wave.

2. Purpose. Inspection of shoreline erosion at Lighthouse Beach in Chatham, MA for possible Federal participation under the Section 14 Authority.

3. Date of Inspection. 26 November 1991

4. Participants.

M. Donovan, Design Division, Civil Engineering Branch
C. Lindsay, Cost Engineering Division
T. Beauchemin, Geotechnical Engineering Div., Design & Facilities Evaluation Branch

5. Site Conditions. The proposed project site consists of approximately 440 linear feet of eroding shoreline in Chatham, MA known as Lighthouse Beach. (See Sketch No. 1) The eroded bank ranges in height from about 33 feet at the south end to about 38 feet at the north end of the site, and slopes at 1 vertical on 1 horizontal or steeper along the entire reach. At the top of the bank is a paved municipal parking lot adjacent to a public street. Approximately 160 linear feet of paved sidewalk and granite curbing, which ran along the sea side of the parking area, has fallen down the slope to the beach. The receding bank is beginning to undermine the edge of the parking lot in a few areas. The erosion was apparently caused by severe wave attack which undermined the toe of the slope and caused the top slope to slump down the slope.

The remains of an armor stone revetment are scattered along the toe of the existing bank. The rock is a dark gray slabby granite with a maximum size of 6 feet in length by 4 to 5 feet in width. About 50% of the existing rock is slabby and only 1 to 2 feet thick. The pile of armor stone along the toe ranges from 2 to 7 feet high and extends along the full length of the base of the slope. There was no evidence of any underlayer stones or filter layers beneath the existing armor stone.

The existing bank materials consist primarily of very clean, stratified, coarse to medium sands (SP). The overburden along

approximately 150 linear feet of the toe of the existing bank consists of compact, stratified inorganic silt (ML). The top of the silt layer forms an arc which rises from 1 foot above the base of the slope at each end to about 6 feet at its center. The top 2 to 3 feet of the silt layer is light brown to brown and appears weathered. Below the brown layer, the silt turns to a dark gray color. There was no evidence of any emerging groundwater along the entire slope. Based on previous topographic surveys performed by others, the base of the slope is at about elevation 3.0 feet NGVD and the top of the slope ranges from about elevation 41.0 feet NGVD at the north end of the site to about elevation 36.0 feet NGVD at the south end of the site. From the toe of the slope, sea side of the existing armor stone, a narrow sand beach slopes very gently toward the ocean. This strip of beach is submerged at normal high tide, approximately elevation 3.3 feet NGVD.

Immediately to the north of the site is an existing armor stone revetment, which was designed by Coastal Engineering Co., Inc. (CEC). This revetment consists of a layer of 4 to 6 ton armor stone placed on a 1 vertical on 1.5 horizontal slope. The armor stone extends up to elevation 20.0 NGVD and down to elevation -4.0 feet NGVD. Beneath the armor stone is a 9 inch thick layer of bedding stone placed on a double layer of geotextile. The toe of the armor stone layer consists of 6 to 8 ton stones. A similar armor stone revetment, also designed by CEC, is currently under construction immediately to the south of the proposed project site.

6. Recommended Design. An armor stone revetment was selected as the best means to prevent further erosion at this site. Armor stone will provide a permanent solution to the shoreline erosion, and will blend in with the existing revetments to the north and south of the site.

Based on studies conducted by the Coastal Engineering Branch, the armor stone should extend up to elevation 20.0 feet NGVD, and should be designed to withstand a 7.0 foot breaking wave with severe toe scour conditions. This design criteria was developed to provide a stable structure during a 100 year frequency storm event. The design of the armor stone revetment was performed in accordance with criteria presented in the Shore Protection Manual, 1984; and in Coastal Engineering Technical Note, "Riprap Revetment Design" CETN-III-1.

Based on the above criteria, a double layer of uniform size armor stone ranging in size from 2.0 to 3.0 tons was selected. This results in a total armor stone layer thickness of 6.0 feet. The armor stone should be placed on a 3.0 foot thick layer of uniform size underlayer stone ranging in size from 400 to 500 pounds. The underlayer stone should be placed on a 1'-6" thick layer of quarry run bedding stone which ranges in size from chips to 50 pounds. The bedding stone should be placed on a geotextile which is designed to separate the compacted random backfill from the bedding stone layer while permitting free drainage of the backfill. (See Sketch Nos. 2 & 3)

The armor stone layers and all bedding layers should be placed on a 1 vertical on 1.5 horizontal slope to minimize encroachment on the intertidal zone. Considering the total thickness of the stone layers, the individual placement methods that will be required for the armor stone layers, and extensive experience with similar materials and structures at New England Division, this structure will have a conservative factor of safety for slope stability. The compacted random fill slope above the top of the armor stone should be 1 vertical on 2 horizontal, and covered with a 6 inch layer of topsoil prior to seeding. This slope should also be stable based upon experience with similar materials.

7. Previous Design. An armor stone revetment was previously designed for this site by CEC. Their design is similar to the New England Division design since it includes a layered system of armor stone, underlayer stone, bedding stone, and geotextile placed on a 1 vertical on 1.5 horizontal slope. CEC's proposed revetment also extends from elevation -5.0 to +20.0 feet NGVD. The primary differences in the two designs are the recommended stone sizes, layer design, and toe design. CEC's recommended armor stones are larger, 4 ton average size, and are only placed in a single layer. NED's design requires two layers of armor stone. Similarly, CEC's recommended underlayer stones are larger, 2 ton average, and are only placed in a single layer. CEC's bedding stone layer consists of a 12 inch thick layer of 6 inch stone as opposed to NED's 18 inch layer of quarry run stone ranging in size from chips to 50 pounds. CEC's toe design consists of setting several very large, 6 to 8 ton armor units at the base of the slope. NED's recommended toe consists of a berm with a 14 foot horizontal top width consisting of an extension of the sloping revetment layers.

8. Construction Considerations. It is assumed that tracked construction equipment can operate on the beach during construction of the armor stone revetment. Work on the toe portion of the revetment must be performed during low tide periods. Access to the beach is available from several locations.

Prior to commencement of any construction activities, the existing armor stones must be removed and stockpiled outside of the limits of the new construction. Most of the existing armor stones can be utilized in the new underlayer or armor stone layers. Stones with satisfactory size and shape characteristics may be placed directly in the appropriate stone layers. Slabby stones not meeting shape criteria should be broken as required to make them conform. To the maximum extent possible, existing stones should be used in the underlayers or in the toe section of the armor stone layers so that the exposed armor stone slope will consist primarily of stones provided from a single source which are fairly uniform with respect to quality, color, and appearance.

Existing beach sand which is excavated from the toe area of the new revetment should be stockpiled to the sea side of the toe for later backfilling over the completed toe berm. If silt materials are encountered in the toe excavation, this material should be separated from the beach

sand and disposed of off site. The toe exavation should extend no deeper than elevation -5.0 feet NGVD. This depth was determined to be a practical excavation limit due to excessive caving and sea water intrusion during excavation of test pits at the site by CEC during their previous design efforts.

All stone work should start at the toe and progress up the slope. Once the toe berm is completed, it can be used as a working platform to complete the sloping section of the revetment.

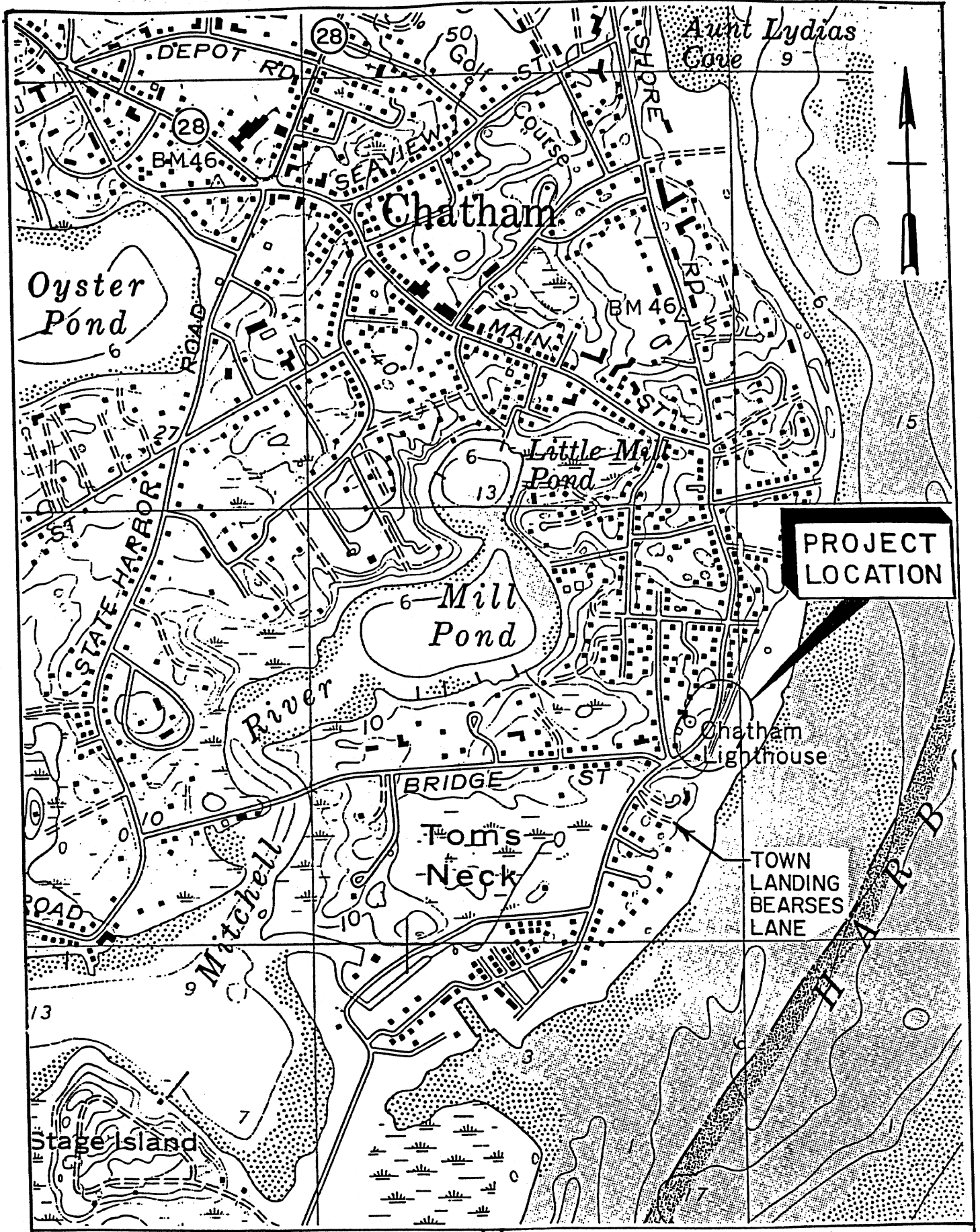
9. Material Gradations.

a. Armor Stone. Armor stone units shall weigh from 2.0 to 3.0 tons. A minimum of 50% of the total tonnage of armor stone shall consist of stones weighing 2.5 tons or more.

b. Underlayer Stone. Underlayer stone units shall weigh from 400 to 500 pounds. A minimum of 50% of the total tonnage shall consist of stones weighing 450 pounds or more.

c. Bedding Stone. Bedding stone shall consist of well-graded quarry run stone ranging in size from chips to 50 pounds.

d. Random Fill. Random fill shall consist of free draining, granular material free of stumps, debris, topsoil, silt, clay, or organic soils such as peat or muck.



PROJECT LOCATION MAP
LIGHTHOUSE BEACH
CHATHAM, MA

SKETCH NO. 1 | | DEC. 191

N

Existing Lighthouse

℄

Property of United States Government
Coast Guard Chatham Light

Town of Chatham

℄

℄

Existing concrete barriers

℄ MAIN STREET

Chatham Beach
Tennis Club

Transition to
match existing

280'±

160'±

Transition to
match existing

Town of Chatham Parking Lot

T.R., II and C.H.
Pennypacker

Existing
revetment
under constr.

Existing granite curb

New granite curb

×El. 36±

Existing bit. conc. sidewalk

×El. 41±

New 6'-wide bit. conc. sidewalk

×El.
34±

Exist. guide rail to be replaced
with new - 440 L.F.

Existing wooden stairway
to be removed

Top of Bank

El. 20.0

New 6" topsoil, seeded

S=1on 2

12'

El. 20.0

El. 20.0

S=1 on 1.5

Existing
revetment

El. 10.0

14'

El. 5.5

Approx. M.H.W.
after 10/30/91
Storm

Limits of sand replacement

S=
1on5.

El. 3.3, Observed
M.H.W. - 9/18/91

Access from
Town Landing
Bearses Lane

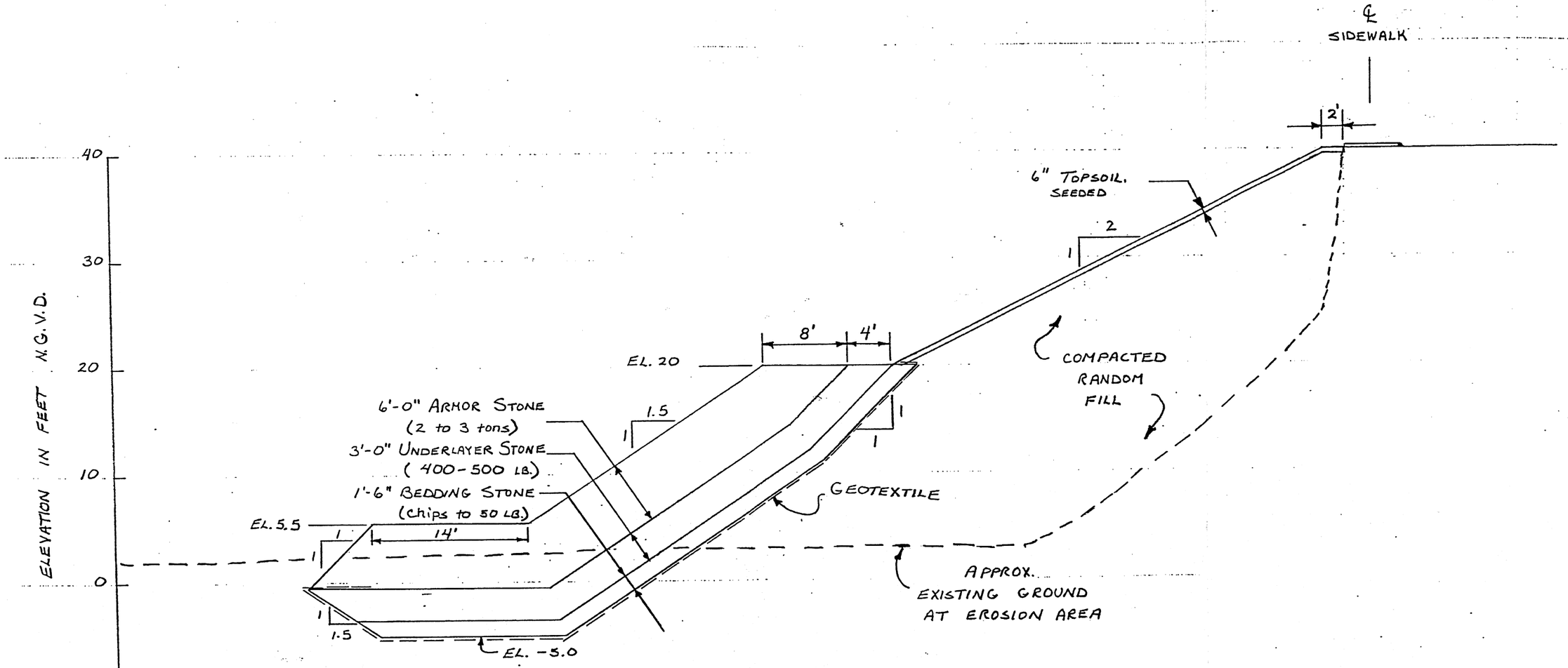
℄

PLAN

SCALE: 1" = 40'

ARMOR STONE REVETMENT PLAN
LIGHTHOUSE BEACH
CHATHAM, MA

SKETCH NO. 2 | DEC. '91



TYPICAL SECTION

SCALE: 1"=10'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

T.L.B. DES. BY	ARMOR STONE REVETMENT
T.L.B. DR. BY	TYPICAL SECTION
CK. BY	LIGHTHOUSE BEACH
	CHATHAM, MA

GEOTECH. ENG. BR. SCALE: 1"=10'
SK. NO. 3 DATE: 11/25/91

The design still water level (SWL), wave height and wave runup for the subject project are as follows:

The SWL is +10 feet NGVD. This SWL has a 100-year recurrence interval and is based on a revised FEMA flood insurance study for the Town of Chatham. This study utilized a two dimensional storm surge model that simulated the surge levels in Chatham Harbor/Pleasant Bay. The 100-year event, either a hurricane or northeaster, having a sustained wind speed of 75 mph from the south-southeast direction was used as the meteorological inputs to the storm surge model.

Based on this storm condition and the resulting SWL, the design wave height and significant wave runup on the proposed revetment was determined to be 7 and 10 feet respectively. This wave runup is based on a structure slope of 1 on 1.5, a nearshore slope of 1 on 50, a water depth at the structure toe of 9 feet, and a significant wave period of 6.5 seconds.

CHATHAM LIGHTHOUSE BEACH

COST ESTIMATE

Quantities are based on observed but unsurveyed site dimensions and the NED designed revetment. This design calls for the removal and stockpiling of the existing stone and excavating sand from the toe of the proposed revetment. The material would be stockpiled adjacent to the excavation in the intertidal area until reused in the revetment.

Construction of the toe would proceed immediately after excavation. Since working elevations reach -5 msl, this work may be impacted by the tides. As the toe is completed, compacted random fill will be placed on the embankment to bring the base grade up to required elevations. Geotextile will then be placed. Revetment layers along with additional fill will be placed alternately as necessary to complete the revetment and the embankment. The embankment will then be top soiled and seeded up to the parking area above.

This work will require the use of a crane with a clamshell bucket, a hydraulic excavator and a front end loader all on tracks. Access to the site is currently available via town landing at Bearse's Lane. The cost of underlayer stone, armor stone and random fill are based on current vendor quotations.

The contingencies for quoted items have been set at 5% to allow for quantity changes based on survey data. A contingency of 25% has been added to all other items. The effective price level date is December 2, 1991. Further erosion from winter storms will require modification to this estimate.

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT CHATHAM LIGHTHOUSE BEACH

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1	EXCAVATE EXISTING STONE	1,110	CY	35-	38,850
2	EXCAVATE SAND	4,000	CY	5-	20,000
3	GEOTEXTILE	3900	SY	3.60	14,040
4	BEDDING STONE C 50#	1,620	CY	30-	48,600
5	UNDERLAYER STONE 400-500	2,620	CY	65-	170,300
6	ARMOR STONE 2-3 TON	4,670	CY	78-	364,260
7	COMPACTED RANDOM FILL	17,000	CY	9.50	161,500
8	6" TOPSOIL + SEED	2,700	SY	6.00	16,200
9	GRANITE CURB	160	LF	25.00	4,000
10	4" BIT. CON SIDEWALK	800	SF	2.00	1,600
11	12" COMP GR. BASE	35	CY	20.00	700
12	REMOVE WOOD STAIRWAY 6X25 ~ 150 SF	1	JOB	LS	500
13	REMOVE GUARD RAIL	280	LF	5-	1,400
14	NEW GUARD RAIL	446	LF	25	11,000
					852,950
	CONTINGENCY - 9 %				74,025
				#	926,975
				SAY #	927,000
				9 DEC 91	BM

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

GPO : 1967 O-261-653

PREPARATION OF PLAN AND SECTIONS

General

A plan of the project area showing existing conditions and proposed improvements is shown on Plate 3. Cross sections at two locations along the proposed revetment are shown on Plates 4 and 5.

Existing Conditions

Existing features shown are based on a site survey, dated April 1991, performed by Coastal Engineering Co., Inc. to support design of a revetment for the Town of Chatham. Plans of their adjacent revetment designs (one since constructed and one currently under construction) were used to approximately locate these revetments for the purpose of tying in the proposed revetment. Existing ground lines shown on the sections represent conditions both before and after the storm of 30 Oct 1991, the latter being approximated during a site visit on 26 Nov 1991.

A topographic survey will be required for final design to accurately show existing conditions, including the as-built locations and elevations of the adjacent revetments.

Layout of Project Features

Alignment of the design section parallels the existing sidewalk which runs along the edge of the parking area at the top of the embankment. The top elevation of the fill was set to match the grade of the existing sidewalk, which varies from El. 41'+/- NGVD at the northern and to El. 36 at the southern end. A two-foot-wide top beam was included to allow for replacement of the guide rail along the edge of the sidewalk.

The design section will transition over a 40'+/- length on each end to match existing slopes.

REAL ESTATE REQUIREMENTS

While the project is primarily located on property of the Town of Chatham, temporary and permanent easements will be required on the adjacent properties. Easements for construction access will also be required along the beach from the proposed access point at the town landing on Bearses Lane.

APPENDIX B

NEWSCLIPS

CHATHAM CURRENT

ORLEANS, MA
WEEKLY

NOV 6 1991

NEW ENGLAND NEWSCLIP AGENCY, INC.
102 DC

Army Corps may save beach bluff

By JENNIFER LONGLEY
Cape Cod Newspapers Staff

Residents will be asked to approve the expenditure of $550,000 at the December special town meeting to pay for a revetment on the bank.

The town is expecting the U.S. Army Corps of Engineers to build a revetment on the bank overlooking Lighthouse Beach assuming an anticipated presidential disaster declaration for the area is issued by President Bush.

The first warning of danger at the popular tourist site was a quarter-inch gap between the sidewalk and the bluff overlooking Lighthouse Beach last Tuesday. The bank had pulled away from the overlook parking lot, pulling back the trash cans and tilting them toward the ocean.

As selectmen, police chief Barry Eldredge, highway surveyor Gilbert Borthwick and spectators surveyed the foreboding sight, a huge section of bank about 20 feet wide dropped 10 feet like an elevator, leaving a gaping void surrounded by fresh soil.

Eldredge and highway department workers detached the trash cans and signs before they tumbled over, and yellow and black plastic tape was put up to keep spectators from standing on what town officials soon realized was unstable ground. The stairs to the beach were blocked with a sawhorse held down with sand bags.

"It looks bleak," executive secretary James Lindstrom said.

"We have a main thoroughfare that's endangered now," Eldredge said. "There's nothing we can do about it now. We're evaluating it minute by minute."

At 5 p.m., Borthwick came to town hall during the selectmen's regular meeting and said the slumping was continuing. At 5:45, police officer Phil Bunting was manning the overlook in the dark keeping people away. The stretch of lost vegetation and exposed earth was then 63 feet long, he said, scanning it with his flashlight.

A police officer was stationed at the overlook around the clock from Tuesday night on.

At their meeting Tuesday, se-

Please turn to page 9

Post 102

[illegible] explored interim measures to stabilize the bank until the planned revetment could be built. At least four subsequent meetings were held to address the ever-changing topography. Each time, Coastal Engineering's Peter Markunas provided town officials with a list of stop-gap measures they could take, and their estimated costs.

The finance committee Thursday approved a $37,000 emergency transfer from the town's reserve account to pay for emergency action.

Friday afternoon, Eldredge told selectmen the erosion on the bank had worsened and another storm, potentially with 11-foot tides, could arrive that weekend. He was considering permanently closing the east end of Main Street.

Selectman vice-chairman Andrew Young wanted to take action on the bank right away.

"We'll lose Main Street soon," he said. "We can't wait until Tuesday (when vacationing coastal engineer Will Joy was to meet with the board). We have to do something immediately."

Saturday, on advice from Joy (who by then had seen the site), the board decided to take no interim steps over the weekend. Emergency action was to be discussed yesterday afternoon.

"It appeared Saturday that the threat of another storm had diminished," executive secretary James Lindstrom said Monday, adding Joyce was concerned temporary action could destabilize the bank.

Residents will be asked to approve the expenditure of $550,000 at the December special town meeting to pay for a revetment on the bank. On Dec. 10, they will be asked to exclude the debt for that expense from the levy limit imposed by Proposition 2½.

Lindstrom said Monday if the Corps does, in fact, build a revetment, there will still be an article on the warrant for the town's share of the cost. He had no idea Monday what that share would be. Until a Corps commitment to build a revetment is final, the article will stay at $550,000.

Prior to news of the Corps possibly building a revetment, Young said if the debt exclusion fails, he will recommend the revetment not be built and let nature take its course. If the debt is not excluded, Young said, the town will not be able to find the approximately $70,000 of debt service for each of the next few years within the levy limit. He pointed out the town is already grappling with a $900,000 shortfall.

"The question is," Young said, "do voters want Main Street to end at the Pennypackers' house."

An old revetment placed on the bluff in the early 1930s had become partially uncovered over the past year. After last Wednesday, it was entirely exposed.

By Wednesday morning, the guardrail had been removed to avoid having to fish it out of the surf if it went over the side. It would have. By Wednesday night, half the sidewalk had fallen over and lay in pieces at the bottom of the bank. Wednesday midday, the entire parking lot was off limits to cars and pedestrians, and by Wednesday night Jersey barriers were put up.

Lindstrom said if the Corps builds the revetment they would use Joy's design.

"The Corps is ready to move in and do the revetment," he said. "We're waiting for a presidential disaster declaration."

Young was skeptical. He said he was concerned that even if the Corps does the work, it may not happen in time.

"The Corps has a tendency to take awhile," he said.

John Smith, chief of the coastal development branch, said Monday he had no idea how fast the Corps could start work.

"If FEMA puts up the money, the Corps can move in and do it," Smith said. "We'll act immediately."

Smith said Colonel Philip Harris, chief of the Corps' New England division, has "taken a personal interest" in protecting the bank."

He said the agency would have to have the cash in hand before any construction began.

U.S. Rep. Gerry Studds' Cape Cod aide, Mark Forest, said Monday Harris visited the site late last week.

"Harris has indicated he would like to see things expedited," Forest said. "When actual work would begin, we don't know. Discussions are ongoing now between the Corps and the town."

Markunas told officials the loss of the bank meant the method of construction of the permanent revetment would change. Work will only be possible at certain times during the day because waves now break over the bank at high tide.

Markunas said any action on the bank would, without question, require a chapter 91 waterways license. He did not anticipate any delay in securing emergency approval from the state Department of Environmental Protection.

Officials briefly discussed dropping fill on the bank even before the storm subsided, but soon realized that would be pointless.

"If you bring in sand in this wind, you better drop it at Andrew Harding's Lane and hope it lands at the lighthouse," Howes said in the height of the storm.

A resident who asked not to be identified said Thursday townspeople were angry selectmen didn't act faster to build a revetment.

"It was moving along as quickly as it could," Lindstrom said later.

He explained Joy was hired this summer to conduct a survey to determine if, in fact, an old revetment, believed to have been built in the 1930s, was there. (It is and, after last week's storm is in full view.) Proving the existence of the old revetment was necessary, Lindstrom said, in order to justify constructing a replacement under state regulations.

Lindstrom pointed out beach accretion during the summers has lulled property owners into a false sense of security. A strong warning signal was received this summer when no build-up occurred. ■

page 2 of 2

Erosion continues as town recovers from damaging storm

CAPE COD CHRONICLE

CHATHAM, MA
WEEKLY 7,500

NOV 14 1991
NEW ENGLAND NEWSCLIP AGENCY, INC.

By [illegible]

CHATHAM — [illegible] Lighthouse Beach continued this week, with wind, rain and high course tides carving out large chunks of banking, pushing the precipice inexorably toward Main Street.

And as residents continued to dig out from the devastating Oct. 30 northeaster, federal and state agencies moved at what can best be described as "government pace" toward construction of a revetment at the lighthouse.

"It's eroding away gradually but very steadily," Chief of Police Barry Eldredge said of the lighthouse bank. Monday's wind and rain contributed to the erosion, further undermining the pavement at the north end and knocking out about three feet of banking at the southern side. "It's back to the sidewalk there," he observed. He planned to ask the highway department to remove more of the guardrail and fencing.

On Tuesday, Chief Eldredge told the selectmen he "wouldn't be surprised if we come back and close [lower Main Street] by Thanksgiving."

The Federal Emergency Management Agency continues to work with the Massachusetts Emergency Management Agency to line up protection for the bank. The town has made its request for emergency help; officials say they now need a similar request from the state.

Ed Lecius, a FEMA spokesman, said state environmental agencies must make an emergency request to FEMA to start the funding gears in motion. Money is available to cover such a request, he said.

The Massachusetts Emergency Management Agency and Coastal Zone Management "are looking at" the situation, said Lecius. "They're keeping us abreast of what's going on. At some point, there will be an emergency request." New England FEMA director Dick Strome said Sunday an emergency request would have to be forwarded to Washington for approval.

Lindstrom said he believes FEMA assessment teams will be looking at public property later this week. "We'll know better when that happens," he said. "I do know the light is getting special attention." A meeting to explain the public assistance program is scheduled for 9 a.m. Friday at the Harwich Town Hall.

Army Corps of Engineers involvement is not certain at this point, although Corps officials have been following the process "informally," according to sources. Lecius said FEMA could issue a mission request to the Army Corps for construction of the revetment or the town could handle the project through private contractors and be reimbursed later. "That has yet to be determined," he said.

FEMA's emergency assistance program will probably be the "quickest" way to get the project

(Continued on Page 18)

done, Lindstrom suggested; under that, the federal government would pay 75 percent, the town 12.5 percent, and the state the remaining 12.5 percent.

"But I haven't got a firm answer from the two federal agencies I've talked to as to what the link is between FEMA and the Army Corps," he said.

Selectmen vice chair Andrew Young was hopeful that something could be initiated within a few weeks. Otherwise, the town cannot take any action until voters approve a Town Meeting article and override question funding the revetment.

"Even with every exemption under the sun, we cannot have complete clearance to sign a contract until at least Dec. 11," he said. Allowing time for a contractor to mobilize would put the beginning of construction right around Christmas.

"At this stage, we're just keeping the pressure on. But I'm not going to bet on anything happening in time for the next storm, whenever that is," said Young.

Dave Shephardson of the Massachusetts Environmental Policy Act office viewed the site last Friday and expected emergency permission to be granted Tuesday. The town must still file a formal application for environmental review, he said, within ten days of the project's commencement.

Engineer Thomas Joy planned to pursue emergency filings with the state Division of Waterways and the Army Corps of Engineers as well.

The Conservation Commission last week issued an order of conditions approving a slightly revised version of Joy's original revetment design for the lighthouse bank, which adds about two feet to the structure's height. Because of the rapidly changing situation, construction methods will be determined

Page 1 of 3

once a contract is awarded. Rebuilding of the infrastructure, the sidewalk, curbing and parking area, [illegible] by the organization pending work [illegible], said Chairman John Quigley. The agency also retained the right to review the bid specifications. [illegible]

Due to the erosion, Coy expects the cost of the project to increase from its initial $550,000, although he could not say by how much. Additional fill – as much as 10,000 cubic yards – contributes to the increase, as will replacing the sidewalk, guardrails and parking areas.

At next Wednesday's meeting, the commission will review two storm-related requests: John Molander wants to amend a previous order of conditions for a revetment fronting his Mistover Lane property, and a request will be made to add additional rocks to the revetment at the Hammond property, according to Peter Markunas of Coastal Engineering.

Numerous residents took advantage of a disaster application center set up by FEMA in the Community Building over the weekend (see story, page 10).

The Red Cross came to the assistance of three owners of property at the end of Holway Street who lost access to their homes after erosion clipped the end of their driveway. According to John Whelan, his neighbors, Doris and Roger Chapdelaine, spoke to Red Cross representatives over the weekend; because there was an immediate need to provide access, for emergency services principally, the agency agreed to fund temporary reconstruction of the end of the road and the driveway.

Contractor George Viprino was at work on the job early this week. Whelan said he, the Chapdelaines and Ellen Ford are "thrilled" by the turn of events. However, a long-term solution must still be worked out; the end of Holway Street was supposed to be protected by a revetment built and paid for by the Whiting Family. Whelan wasn't sure if that would happen now, since part of the Whiting home was destroyed by the storm.

Viprino turned down a $35,000 override to reset the end of Holway Street last summer. "The town has some responsibility," Whelan remarked, "but I know it doesn't have the money."

About a dozen fishermen organized work parties Saturday and Monday mornings to remove debris from the shoreline north of the fish pier. Fishermen were unhappy with the town's decision not to clean that stretch of beach, said Michael Ryder, and were also concerned that a high tide would take the material back into the water, where it would be a hazard to navigation.

"We also wanted to help the property owners," who would otherwise have to hire contractors to remove the debris, the area is difficult to reach. "They've been good to us over the years."

J.P Vario and Paul Avellar volunteered to operate a front end loader and dump truck donated by Robert Our, Inc., of Harwich. The town sent a second dump truck on Monday morning. Ryder estimates 15 or 16 truckloads of material were removed from the beach during the two-day cleanup.

Refined estimates of damage to town property were not completed by Tuesday, according to Lindstrom. The observation deck at the fish pier, however, was closed, after officials tore apart the packing building's east-facing wall and discovered that wave action during the storm had cracked studs.

Areas where the deck is bolted to the building have been "compromised" by the damage, observed Wharfinger Stuart Smith. "I think it's just a precaution, to be honest." He estimated the damage to the building at roughly $7,000 and figured the work would take about two weeks. The structure is covered by both the town's insurance and federal flood insurance. Damage is not severe enough to restrict the tenant packers from offloading fish, however.

Last Tuesday afternoon, Chief Eldredge and Park Superintendent Dan Tobin and viewed the shoreline from the air in the Barnstable County airplane.

"What we saw was not good," said Chief Eldredge. At high tide, 70 percent of South Beach appeared to be underwater; there were numerous washovers, he said, and most of the dunes had been flattened. The chief expressed a desire to see the beach from the air again, this time at low tide, to better judge the ultimate impact of the storm.

Tobin said he is worried about South Beach, which seems to be "shrinking fast. Even a moderate storm could do quite a lot of damage."

On the mainland, Chief Eldredge said there was "a lot of water in places we've never seen water before." The amount of debris along the shore, he added, was "much more than we estimated."

The weekend's inclement weather also caused additional flooding of the marsh between Andrew Harding's Lane and Holway Street, said Chief Eldredge. It will have to be pumped again so that a mosquito control drainage ditch can be reconstructed.

Page 2 of 3

Storm assessment continues in town

US Army Eng.

By CINDY ROY
Cape Cod Newspapers Staff

Assessment of damage from last week's storm continued over the weekend, with Spring Hill Beach being the area most significantly damaged by the extreme wind and high tides.

While ocean waters broke through in two areas on Town Neck Beach, the newly reconstructed dunes, along with the vegetation, remained nearly intact, but the already damaged boardwalk was further dismantled. The portion starting at the end of Boardwalk Road was disconnected from its pilings and now sits in the parking lot. Last Wednesday's late afternoon high tide pushed by strong northeast winds, rose to cover the road and marsh.

Over at Horizon's on Cape Cod Bay, manager Kathleen Fuller explained how they had to "tell" people to leave the restaurant at about 3 p.m. due to rising waters which were cascading over the adjacent parking lots.

"It was amazing the number of people we had," Fuller said. "We were busier that day than we've been in weeks."

The lower function room had water and sand damage to the carpeting. The restaurant reopened last Thursday at 11:30 a.m.

"Basically, we just had a mess," she said. "There was sand everywhere. The porch resembles a beach. We were much luckier than we could have been."

Joe's Lobster and Fish Mart did not have any water in the building, but at one point it was surrounded.

At the adjacent Sandwich Marina, manager and harbormaster Mark Hastings admitted there were "some mad moments" as the water level rose to being chest deep on the walkways. A transient commercial boat smashed part of the commercial dock, and the B

Please turn to page 18

HUNGRY OCEAN WATERS: Many Spring Hill Beach residences, like these, lost their foundations as the storm's extremely high tide pounded the dunes. *(Staff by Cindy Roy)*

Page 1 of 3

were rescued in the midst of the storm by deputy police chief Wayne Love Wednesday morning.

Because of the extent of the devastation, the police department closed North Beach for the next two to four months, reported fire captain Peter Connick.

At noon last Wednesday, the emergency operations center was activated at the police station and continued monitoring and coordinating emergency activities through Monday. At 6 p.m. last Wednesday, selectmen issued an emergency declaration for the bank over Lighthouse Beach. Friday afternoon, the board declared the east coast of town from Jackknife Harbor to Morris Island a disaster area.

School was let out at noon last Wednesday because police were concerned flooding would prevent some children from getting home. Schools reopened Thursday.

Late that afternoon, Governor Weld declared a state of emergency for Barnstable County and other coastal counties throughout the state. Yesterday morning, the town was still awaiting an anticipated presidential disaster declaration from President Bush which would make available federal funds to defray some of the costs incurred by the storm.

That was good news to executive secretary James Lindstrom, who said last week Hurricane Bob "wiped us out of cash."

With the disaster declaration in hand, Lindstrom said, the Corps of Engineers will likely, at the direction of the Federal Emergency Management Agency (FEMA), assume responsibility for building the revetment on the Lighthouse Beach bluff that the town had been planning. The town will still contribute a portion of the cost.

Lindstrom did not yet know Monday what the town's share would be or how soon the Corps would start building.

Although no one was ordered to leave, dozens of residents were evactuated last Wednesday afternoon, at least one reluctantly, reported fire captain Richard Hunter. David Ovans, an 86-year-old resident of Andrew Harding's Lane, insisted on staying in his home. He was eventually convinced to leave by fire chief William Schwerdtfeger and police chief Barry Eldredge.

Feeling secure on Water Street, resident Charlotte Ventola opted not to leave her home.

"I wouldn't think of leaving," she said. "I didn't leave during Hurricane Bob. If anything happened, I'd have to be here to take care of everything."

Ventola's house did "take a hit," she said. A mighty wave crashed through one of her sliding glass doors and pushed a desk up against a back wall. The brown wave brought with it enough sand to cover the floor of the room. Walking in that room, Ventola said, was like walking on the beach. She spent most of Thursday clearing sand from her home.

Like many, Ventola considers herself fortunate and is thankful the damage was not worse.

A shelter was opened last Wednesday afternoon at the high school, where the Red Cross provided a hot supper to a handful of evacuees. No one spent the night and it was closed Thursday.

Thursday morning, the state Division of Marine Fisheries closed most of Chatham's shellfish beds until yesterday because of potential contamination from flooded sewer systems and grounded boats.

The Coast Guard was searching last Tuesday night for a man who tried to row his dinghy out to his boat in Stage Harbor to secure it. According to petty officer Eugene Mosher, the resident, whose name he did not know, lost control of his dinghy after losing an oar. Unbeknownst to the Coast Guard at the time, he and his boat drifted to Hardings Beach and he walked back to his car.

The police department kept traffic moving around the lighthouse and spectators away from the overlook all week. The Massachusetts Turnpike Authority came down Wednesday evening with Jersey barriers to block off the overlook parking lot and to prevent the curious from peering over what was left of the cliff.

The sea didn't crash into George Ganaway's house at 24 Andrew Harding's Lane, but James Fitchett's cottage, No. 28, did after breaking free from its foundation and sailing several feet into the other building. Both structures were condemned by Child.

Main Street resident Victor Tyler saw the Fitchetts' cottage when it was waterborne. It moved slowly, he said, so slowly that decorative red and blue bottles in the kitchen window sill were still standing after the house came to a halt against the Ganaway home.

The Fitchetts took advantage of Saturday's Indian Summer weather to salvage what they could from the house where flooding was three feet high inside. The Fitchetts' adjoining garage was demolished by the storm. Much of its contents had blown to a vacant lot behind the Ganaways' home. Susan Patterson, a family friend, was searching a flooded area of the lot for china that was in the garage. Framed photographs, a brass light and other items she had already found were drying on the grass.

Marco Odiaga was inspecting his parent's home at 170 East Main St. Thursday. The house had escaped structural damage, but he was concerned about possible salt water intrustion into the septic system.

"For four years, we've been waiting and hoping," he said. "After a while, you start kidding yourself and begin thinking, 'Maybe it'll be O.K.'."

Flooding on Morris Island Road was so extensive it was impassable about half a mile down from the lighthouse. Two cars were partly submerged in a lake that had formed on the road. By Friday at noon, that road and others had been pumped out by the Army Corps and the highway department, according to fire captain Richard Hunter. Hunter said Morris Island suffered little damage from the storm.

Lindstrom called the overall damage devastating and Eldredge Thursday morning called the situation "extremely bad.

"The more we evaluate, the worse it gets," he said. "The damage is severe. It's definitely much worse than we thought."

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Residents of heavily damaged sections of town lined up outside the police station Thursday morning to obtain passes to their homes behind police blockades. State and Registry of Motor Vehicles police were called in to assist Chatham's force.

State Sen. Henri Rauschenbach, R-Brewster, toured the shoreline for more than an hour with Lindstrom and Eldredge Thursday. He was then on his way to meet with Governor Weld to apprise him of the extent of Chatham's losses. Rauschenbach was optimistic state funds would be forthcoming.

The senator saw Scatteree and Claflin Landings, the fish pier, Holway Street and Andrew Harding's Lane, the overlook and extensive flooding on Morris Island Road.

He said he was staggered by the intense power of the ocean and nature and thought the damage was worse than expected.

The Red Cross opened an office in the community building Sunday to provide food, medical supplie, clothing and to assist residents forced to evacuate their homes with relocation costs. It will also replace some occupational equipment lost in the storm — fishing gear or carpentry tools, for example. Between Sunday and Monday, three Chatham families had registered for assistance.

Dan Hughes at Chatham's temporary Red Cross office said everything it provides is a gift. No financial assistance has to be paid back. ■

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APPENDIX C

LETTERS OF INTENT

TOWN OF CHATHAM

Office of the Selectmen

December 13, 1991

Colonel Philip R. Harris, Division Engineer
Corps of Engineers - New England Division
Department of the Army
424 Trapelo Road Building #100
Waltham, MA 02254-9149

Dear Colonel Harris,

The Board of Selectmen support your efforts on our behalf to construct a revetment on lower Main street in the vicinity of the Chatham Light. As a result of the October storm, the embankment has seriously eroded and has already lost portions of the sidewalk. The road itself is a main traffic artery, connecting to residents of the Little Beach area and streets to Morris and Stage Islands. We have secured our portion of the funding at a Special Town Meeting December 2 and subsequent debt exclusion election December 10. As we have indicated previously, in our letters of August 29 and October 10, time is of the essence and we hope review and approval will be speedily accomplished.

Very truly yours,

Norman H. Howes
Chairman

NH/rmw

TOWN OF CHATHAM

Office of the Selectmen

TOWN OF CHATHAM JUNE 11 1712 MASS

May 31, 1991

Colonel Philip Harris
US Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Harris,

In addition to the continued shoaling occurring at Aunt Lydia's Cove, the Town of Chatham is experiencing significant erosion in front of the Chatham Coast Guard Station at Lighthouse Beach. We reviewed the area with Captain Anthony Pettit, Woods Hole Group Commander, who came away stating that this was the most threatened area of the Coast Guard's facilities. We would like to request that funds be made available from Section 103, Shore Protection of the Rivers and Harbors Act of 1962 so that together with the Coast Guard and the Town, we can develop and implement an effective protection for this area.

Very truly yours,

Norman H. Howes
Chairman

NH/wnh

Massachusetts 02633 (508) 945-2100